

**REMARKS**

Claims 1-8 and 11-14 are pending in this application. Applicants reserve the right to pursue the original and other claims in this and other applications. Applicants respectfully request reconsideration in light of the above amendments and the following remarks.

The Specification has been amended to correct a formatting error in Table 3. The application as filed included the information shown in the amendment above. Applicants submit this amendment in order to ensure appropriate formatting upon allowance of the application. The Specification has also been amended to replace the “\*” in the formulas with the multiplication symbol “x”.

Claims 1-8 and 11-13 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Partridge et al. (U.S. Patent No. 4,820,402) (“Partridge”) in view of Gentry (U.S. Patent No. 6,261,441) (“Gentry”). This rejection is respectfully traversed and reconsideration is respectfully requested.

Claim 1 recites a “process for preparation of middle distillates by selective conversion of a hydrocarbon containing feedstock under hydrocracking conditions with a hydrocarbon conversion catalyst comprising one or more hydrogenation components supported on a support comprising a beta zeolite and an amorphous inorganic oxide, the beta zeolite having a SiO<sub>2</sub>: Al<sub>2</sub>O<sub>3</sub> molar ratio of at least 50, and the amorphous inorganic oxide consisting of silica-alumina and alumina and combinations thereof, the support having an Ion Exchange Capacity-Acidity Index of less than 3.7, the support comprising less than 50 wt % zeolite beta.”

Applicants respectfully submit that, for at least the reasons discussed below, the cited combination (even if combinable) does not disclose, or render obvious, all features of the claimed invention.

Applicants respectfully submit that Partridge does not disclose, or render obvious, the claimed catalyst acidity. The only mention of acidity in Partridge is in the general statement that

the acidity of the catalyst is contributed by the zeolite. However, no consideration is given in Partridge to the support. As noted by the Examiner, the support in Partridge is limited to alumina. Office Action, pg. 3. As would be known to one of skill in the art, alumina is regarded as non-acidic. Further, with respect to the claimed "Ion Exchange Capacity-Acidity Index" and "NH<sub>3</sub>-TPD Acidity Index" values, the Examiner states that the value of these parameters are "dependent on the silica:alumina ratio of the zeolite" and therefore would "overlap the limitations of the claims." Office Action, pg. 3. However, Applicants note that these acidity index values are dependent on the properties of the *combined* zeolite and amorphous oxide and NOT on the zeolite alone. See, Specification, pg. 22, line 6 – pg. 24, line 5. Thus, the Ion Exchange Capacity-Acidity Index and NH<sub>3</sub>-TPD Acidity Index of the catalyst in Partridge would not necessarily overlap those of the claims, as asserted by the Examiner.

In particular, as shown below, the Ion Exchange Capacity-Acidity Index (IEC-AI) value of the catalyst disclosed in Partridge can be approximated to be 50, which is much greater than the claimed value of "less than 3.7." Partridge discloses (in example 11) a hydrocracking catalyst having a support consisting of 50 wt % beta zeolite (with silica:alumina ratio of 30) and 50 wt% gamma alumina. See, e.g., Partridge, col. 12, line 66 – col. 13, line 4. The ion exchange capacity, IEC, of a beta zeolite with silica:alumina ratio of 30 can be approximated to be equal to the ion exchange capacity of a beta zeolite with silica:alumina ratio of 25,<sup>1</sup> as these values of silica:alumina ratio are close to each other. The formula below, as defined in the Specification of the present application, uses 1 wt% of a beta zeolite with silica:alumina ratio of 25 present in a support containing 99 wt% of another material as the standard material<sup>2</sup> used for normalizing all measured supports. See, Specification, pg. 23, line 24 – pg. 24, line 5. Using this information, the IEC-AI value of the Partridge catalyst can be calculated to be:

$$\text{IEC-AI} = \frac{(18500 \text{ wt ppm Na}) \times (50 \text{ wt\%})}{(18500 \text{ wt ppm Na}) \times (1 \text{ wt\%})} = 50$$

<sup>1</sup> 18,500 wt ppm Na (Specification, pg. 23, lines 27-30).

<sup>2</sup> This standard material has an IEC of 18,500 wt ppm Na. (Specification, pg. 23, lines 27-30).

Therefore, a catalyst based on the support disclosed in Example 11 of Partridge does not disclose, or render obvious, the catalyst as claimed (having an IEC-AI of less than 3.7) and is not suitable for the selective preparation of middle distillates. Additionally, Partridge is completely silent regarding IEC-AI values of catalyst supports, and there is no teaching in the examples that IEC-AI values of the catalyst support that are lower than 3.7 are beneficial in the selective preparation of middle distillates. Accordingly, Partridge does not disclose, or render obvious, the use of a catalyst having the claimed acidity properties.

Further, the Office Action states that Partridge teaches a process for hydrocracking a feedstock to form middle distillate using beta zeolite. Office Action, pg. 3. Applicants respectfully disagree. Partridge relates to increasing the selectivity to the production of *higher boiling distillate range products* which can include gasoline and higher boiling distillate products. The claims, on the other hand, are directed to producing *middle distillates*. Partridge does not disclose a process for hydrocracking a feedstock to form *middle distillates*, as required by the claims.

Additionally, Applicants submit that Partridge does not disclose, or render obvious, the use of high silica:alumina ratio *beta* zeolites. Instead, Partridge includes a very broad teaching in which beta zeolite is just one of six zeolites disclosed. However, when reviewed in more detail, it is apparent to one of skill in the art that Y and ZSM 20 would be preferred zeolite catalyst components and that beta zeolite has inferior performance as compared to Y and ZSM 20 zeolites. As seen in Example 11 and Fig. 1, Partridge illustrates an increase in selectivity with an increase in silica:alumina ratio for Y and ZSM 20 zeolites, with two ratios being given for each. However for beta zeolites, only one ratio is given, so no influence of the silica:alumina ratio on the performance of beta zeolites is illustrated. Any possible influence cannot be determined based on the influence seen in the Y and ZSM 20 zeolites, since it is well known to those familiar with the art that the properties of beta zeolite often cannot be predicted from those of other zeolites. The only beta zeolite example in Partridge (which incidentally is also outside the claimed silica:alumina ratio of greater than 50) has an inferior performance as compared to Y and ZSM 20 zeolites. Thus, Partridge suggests the preferred use of the other disclosed zeolites (e.g., Y and ZSM 20 zeolites).

Additionally, Applicants submit that Partridge does not disclose, or render obvious the use of a *high silica:alumina ratio* beta zeolite. Even though Partridge discusses the preparation of other types of zeolites with high silica:alumina ratios, none of the examples show a high ratio *beta* zeolite, as claimed. Further, there is no disclosure or suggestion in Partridge regarding performance benefits of using of a higher silica:alumina ratio beta zeolite. Accordingly, Partridge does not disclose, or render obvious, the use of high silica:alumina ratio beta zeolites, as required by the claims.

Enclosed for the reference of the Examiner is additional Experimental Data (Examples 10-13), previously submitted during International Examination. The experimental data of the examples demonstrate that the use of a zeolite beta having a silica:alumina ratio of less than 50 as proposed in Example 11 of Partridge leads to an inferior selectivity to middle distillates.<sup>3</sup>

Gentry is relied upon as disclosing the percentage of zeolite present in the catalyst (Office Action, pg. 3), but does not remedy the deficiencies of Partridge discussed above with respect to the particular properties of the catalyst.

Accordingly, Applicants respectfully submit that claim 1 is allowable over the cited combination. Claims 2-8 and 11-13 depend from claim 1 and are allowable along with claim 1.

Additionally, with respect to claim 2, Applicants respectfully submit that the cited combination also does not disclose, or render obvious, a support having the claimed "NH<sub>3</sub>-TPD Acidity Index of less than 3.5." As noted above Partridge discloses (in example 11) a hydrocracking catalyst having a support consisting of 50 wt % beta zeolite (with silica:alumina ratio of 30) and 50 wt% gamma alumina. See, e.g., Partridge, col. 12, line 66 – col. 13, line 4. The NH<sub>3</sub>-TPD of a beta zeolite with silica:alumina ratio of 30 can be approximated to be equal to the NH<sub>3</sub>-TPD of a beta zeolite with silica:alumina ratio of 25,<sup>4</sup> as these values of silica:alumina ratio are

<sup>3</sup> The attached Example 12 is a comparative example provided to show the acidity measurements performed on a catalyst having a support based on standard zeolite beta having a silica:alumina ratio of 25. The attached Example 13 is previously included Example 12, renumbered and including comments on Examples 10-12. The attached Examples 10 and 11 have been clarified to make clear that the acidity values obtained are those of the catalyst support.

<sup>4</sup> 0.90 mmole NH<sub>3</sub>/g zeolite (Specification, pg. 23, lines 13-15).

close to each other. The formula below, as defined in the Specification of the present application, uses 1 wt% of a beta zeolite with silica:alumina ratio of 25 present in a support containing 99 wt% of another material as the standard material<sup>5</sup> used for normalizing all measured supports. See, Specification, pg. 23, lines 8-20. The NH<sub>3</sub>-TPD Acidity Index of the Partridge catalyst can, thus, be calculated to be:

$$\text{NH}_3\text{-AI} = \frac{(0.90 \text{ mmole NH}_3/\text{g zeolite}) \times (50 \text{ wt}\%)}{(0.90 \text{ mmole NH}_3/\text{g zeolite}) \times (1 \text{ wt}\%)} = 50$$

Therefore, a catalyst based on the support disclosed in Example 11 of Partridge does not disclose, or render obvious, the catalyst as claimed (having an NH<sub>3</sub>-TPD acidity index of less than 3.5). Accordingly, claim 2 is allowable for this additional reason.

Applicants respectfully request that the rejection of claims 1-8 and 11-13 be withdrawn and the claims allowed.

Claims 1-8 and 11-14 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Partridge in view of Fragelli et al. (U.S. Patent No. 6,103,101) ("Fragelli"). This rejection is respectfully traversed and reconsideration is respectfully requested.

Fragelli is relied upon as disclosing the amorphous percentage of the catalyst (Office Action, pg. 5), but does not remedy the deficiencies of Partridge discussed above. Additionally, the Fragelli patent is directed to the preparation of lube oils, which would not be considered a middle distillate by one of skill in the art. Further still, Fragelli merely generalizes regarding the zeolites used and refers only to a zeolite having a particular unit cell size, which as would be known to one of skill in the art, could only refer to zeolite Y and not beta zeolite, as claimed.

Accordingly, Applicants respectfully submit that claim 1 is allowable over the cited combination. Claims 2-8 and 11-14 depend from claim 1 and are allowable along with claim 1. Applicants respectfully request that the rejection be withdrawn and the claims allowed.

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<sup>5</sup> This standard material has an NH<sub>3</sub>-TPD of 0.90 mmole NH<sub>3</sub>/g zeolite (Specification, pg. 23, lines 13-15).

In view of the above, Applicants believe the pending application is in condition for allowance.

Dated: June 28, 2010

Respectfully submitted,

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Attachments: Additional Experimental Data (2 pages)

PCT Application PCT/EP03/06585

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14 July 2004

**Example 10**

A catalyst was prepared in the same way as in Example 1 containing 10 wt% of a commercially available zeolite Y type having a specified  $\text{SiO}_2:\text{Al}_2\text{O}_3$  molar ratio of about 15, an  $\text{NH}_3$  TPD of 0.118 mmole  $\text{NH}_3/\text{g}$  zeolite and an IEC of 2105 wtppm sodium and resulting in an  $\text{NH}_3\text{-AI}$  of 1.311 and a IEC-AI of 1.249 of the support.

**Example 11**

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A commercially available zeolite beta with a specified  $\text{SiO}_2:\text{Al}_2\text{O}_3$  molar ratio of about 300, an  $\text{NH}_3$  TPD of 0.151 mmole  $\text{NH}_3/\text{g}$  zeolite and an IEC of 2870 wtppm sodium, was mixed with 38 wt% amorphous silica-alumina (high alumina type) and 55 wt% gamma alumina to obtain 7 wt% zeolite in the catalyst support, resulting in an  $\text{NH}_3\text{-AI}$  of 1.174 and an IEC-AI of 1.086 of the support. The mixture was extruded to form 1/16" extrudates. The extrudates were calcined and impregnated as in Example 1.

**Example 12**

A commercially available standard zeolite beta (CP 814E from Zeolyst International) with a specified  $\text{SiO}_2:\text{Al}_2\text{O}_3$  molar ratio of about 25, an  $\text{NH}_3$  TPD of 0.90 mmole  $\text{NH}_3/\text{g}$  zeolite and an IEC of 18,500 wtppm sodium was mixed with 35 wt% amorphous silica-alumina (high alumina type) and 55 wt% gamma alumina to obtain 10 wt% zeolite in the catalyst support. The resulting support had an  $\text{NH}_3\text{-AI}$  of 10 and an IEC-AI of 10. The mixture was extruded to form 1/16" extrudates. The extrudates were calcined and impregnated as in Example 1.

**Example 13**

The catalysts prepared in Examples 10, 11, and 12 were tested according to the procedure given in Example 9 except that Feed B with the properties given in Table 3 was used.

Testing of the catalyst containing zeolite Y prepared in Example 10 and having a support with an NH<sub>3</sub>-AI of 1.311 and an IEC-AI of 1.249 resulted in a selectivity to middle distillates of 69.1%.

○ The catalyst prepared in Example 11 containing zeolite beta with a support having an NH<sub>3</sub>-AI of 1.174 and an IEC-AI of 1.086 resulted in a selectivity to middle distillates of 71.9%.

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The catalyst prepared in Example 12 containing standard zeolite beta with a support having an NH<sub>3</sub>-AI of 10 and an IEC-AI of 10 resulted in a selectivity to middle distillates of 62.1%.

Example 13 illustrates that the catalyst containing zeolite beta in accordance with the present invention is clearly more selective to middle distillate than the catalyst based on zeolite Y on a support with similar NH<sub>3</sub>-AI and IEC-AI. The catalyst based on a standard zeolite beta having a support with an NH<sub>3</sub>-AI and IEC-AI greater than 3.5 gives a very poor selectivity to middle distillates.